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Morris et al.

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(54) **OPERABLE RAMP**

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(22) Filed: **Dec. 3, 2014**

Related U.S. Application Data

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(51) **Int. Cl.**

E04F 11/06	(2006.01)
E04F 11/00	(2006.01)
E01C 15/00	(2006.01)

(52) **U.S. Cl.**
CPC ***E04F 11/002*** (2013.01); ***E01C 15/00*** (2013.01)

(58) **Field of Classification Search**
USPC 14/71.1, 71.3; 414/921; 187/200; 52/183
See application file for complete search history.

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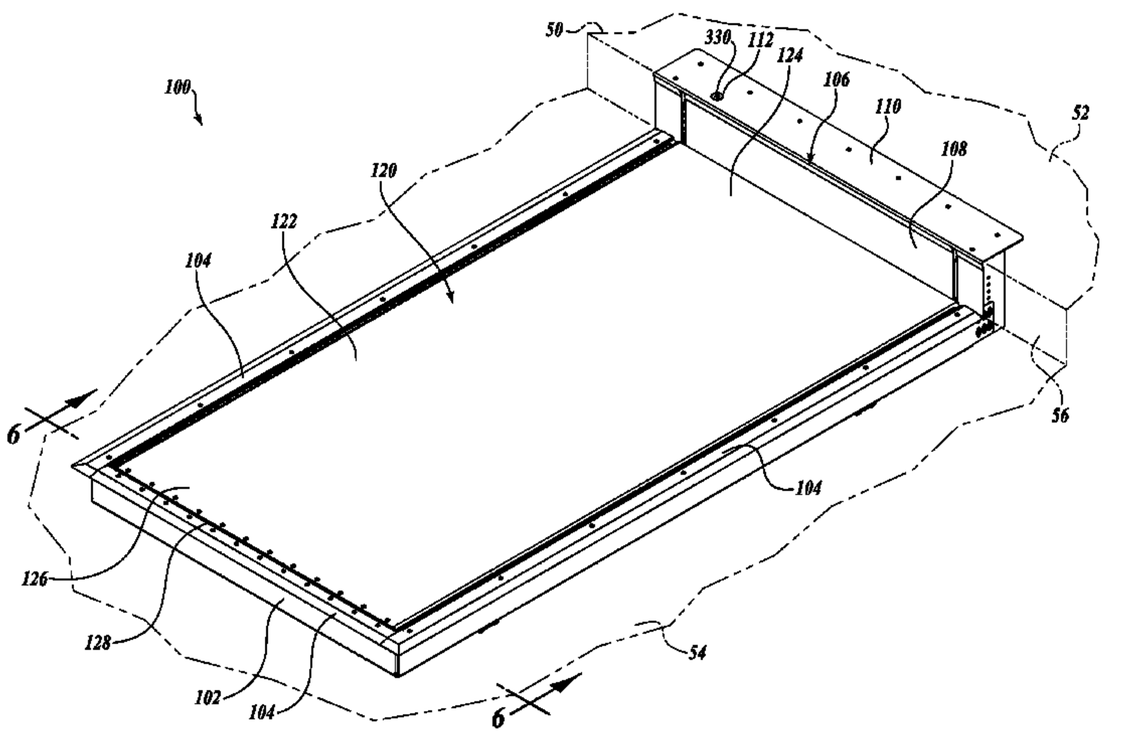
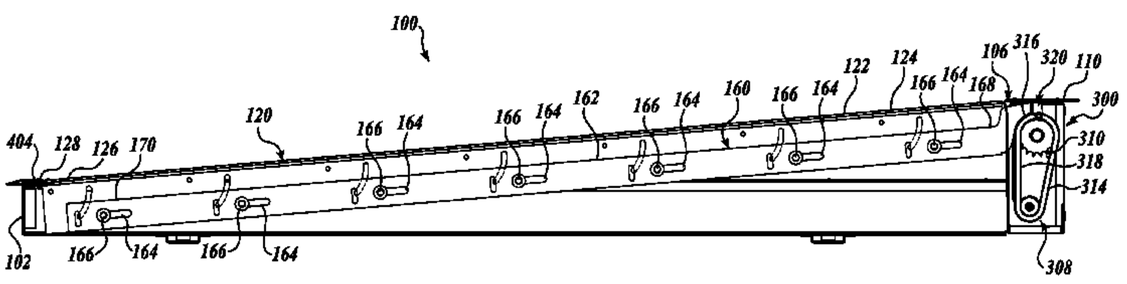
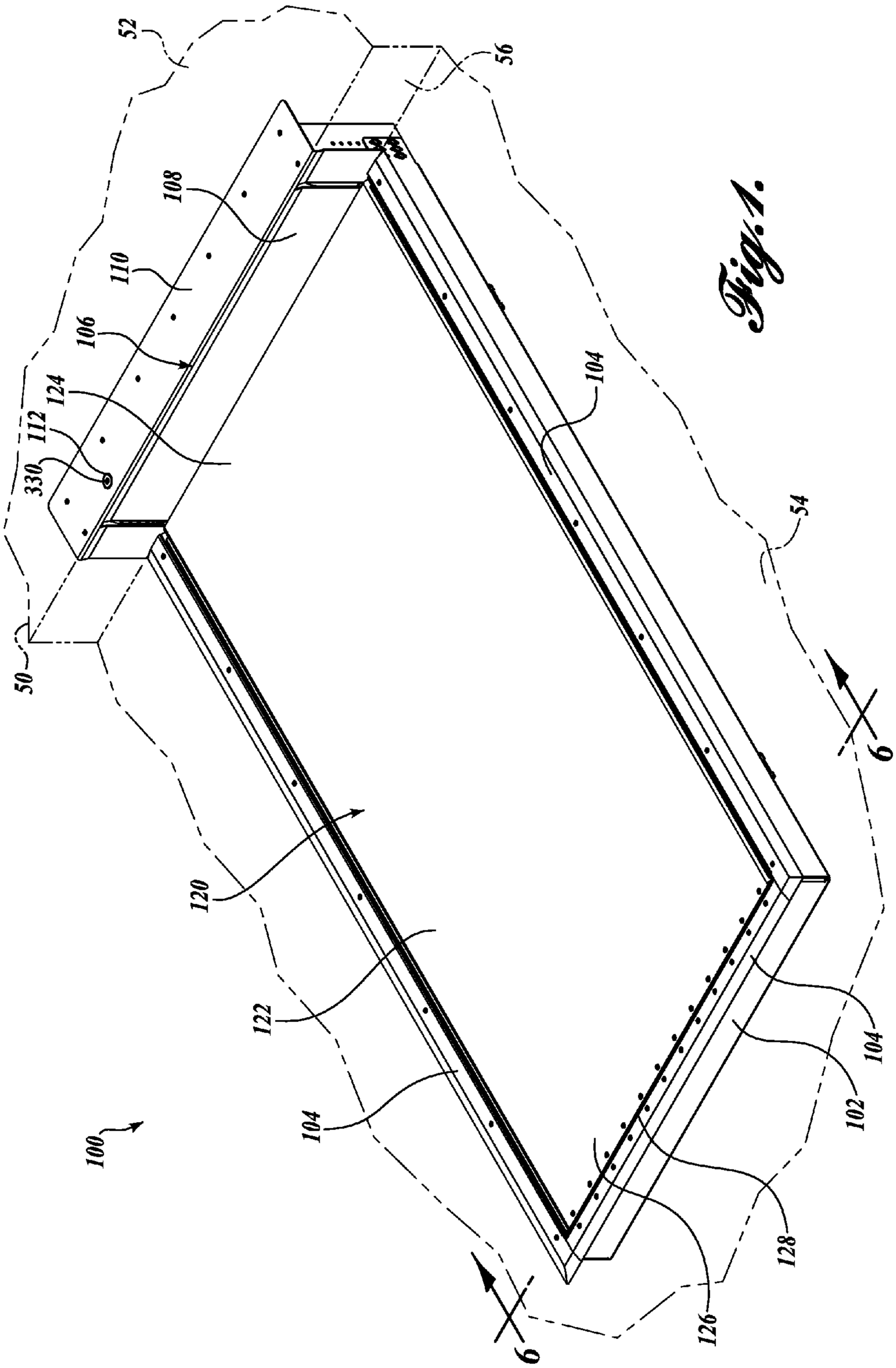
(57) **ABSTRACT**

An operable ramp is moveable between a lowered stowed position and a raised deployed position. The operable ramp has a ramp panel rotatable about a first axis located at a first end. A support element is slidingly coupled to the ramp panel. The operable ramp further includes a drive assembly comprising an endless loop coupled to an end of the support element. The endless loop has a linear portion and an arcuate portion. During a first phase of deployment, the end of the support element moves upward along the linear portion. During a second phase of deployment, the end of the support element moves along the arcuate portion of the endless loop.

5 Claims, 16 Drawing Sheets






52
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100

Fig. 1.

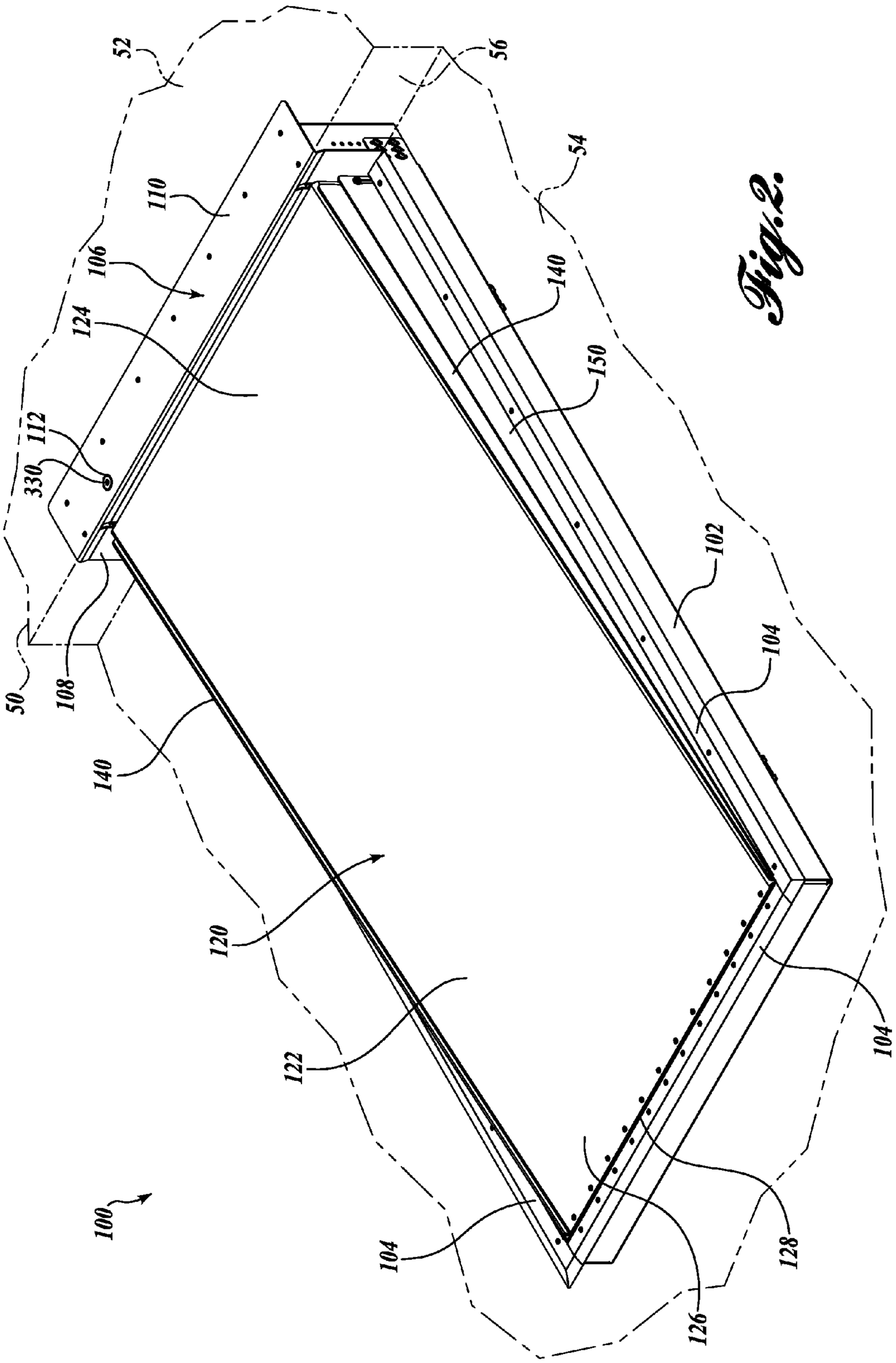
52
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Fig. 2.

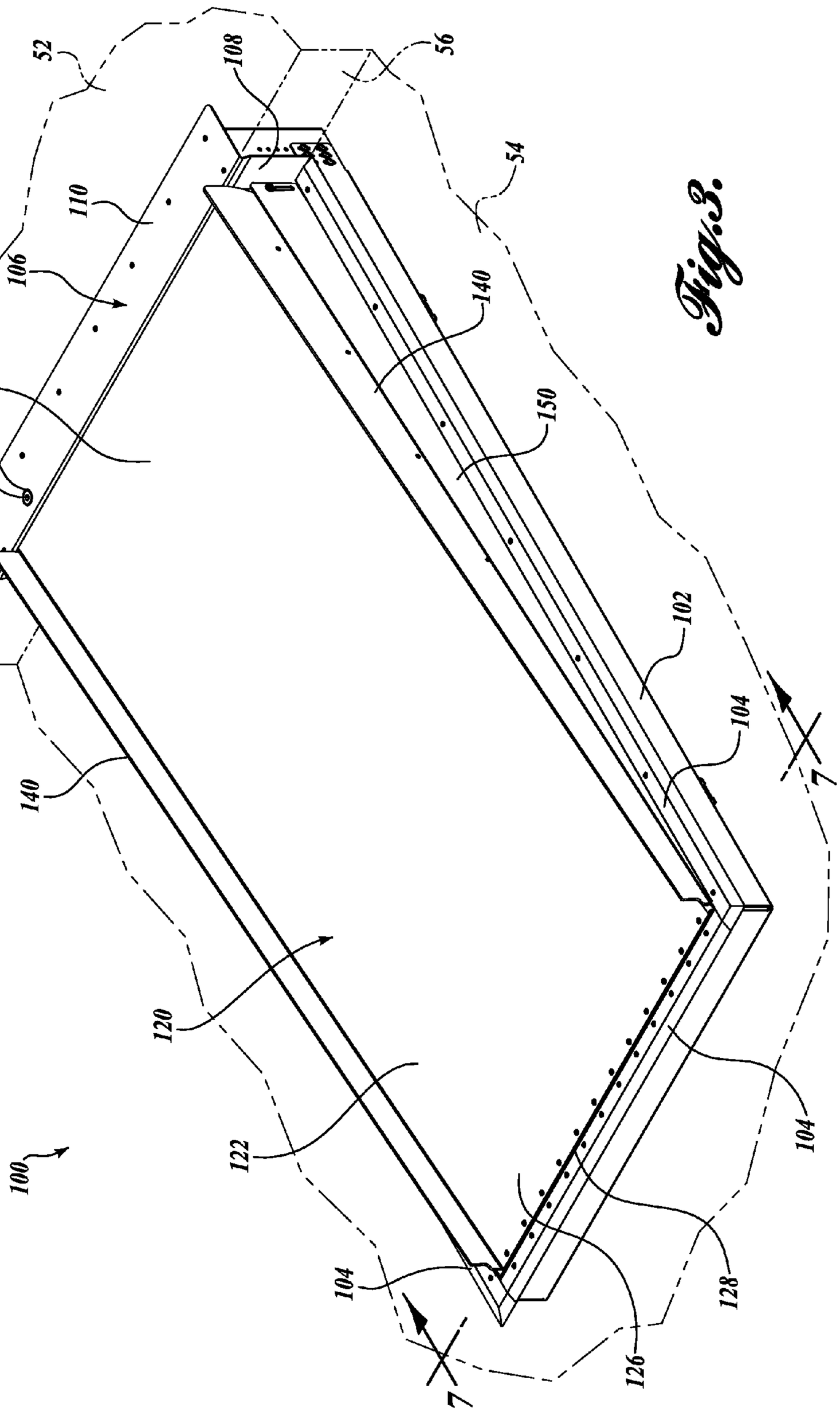
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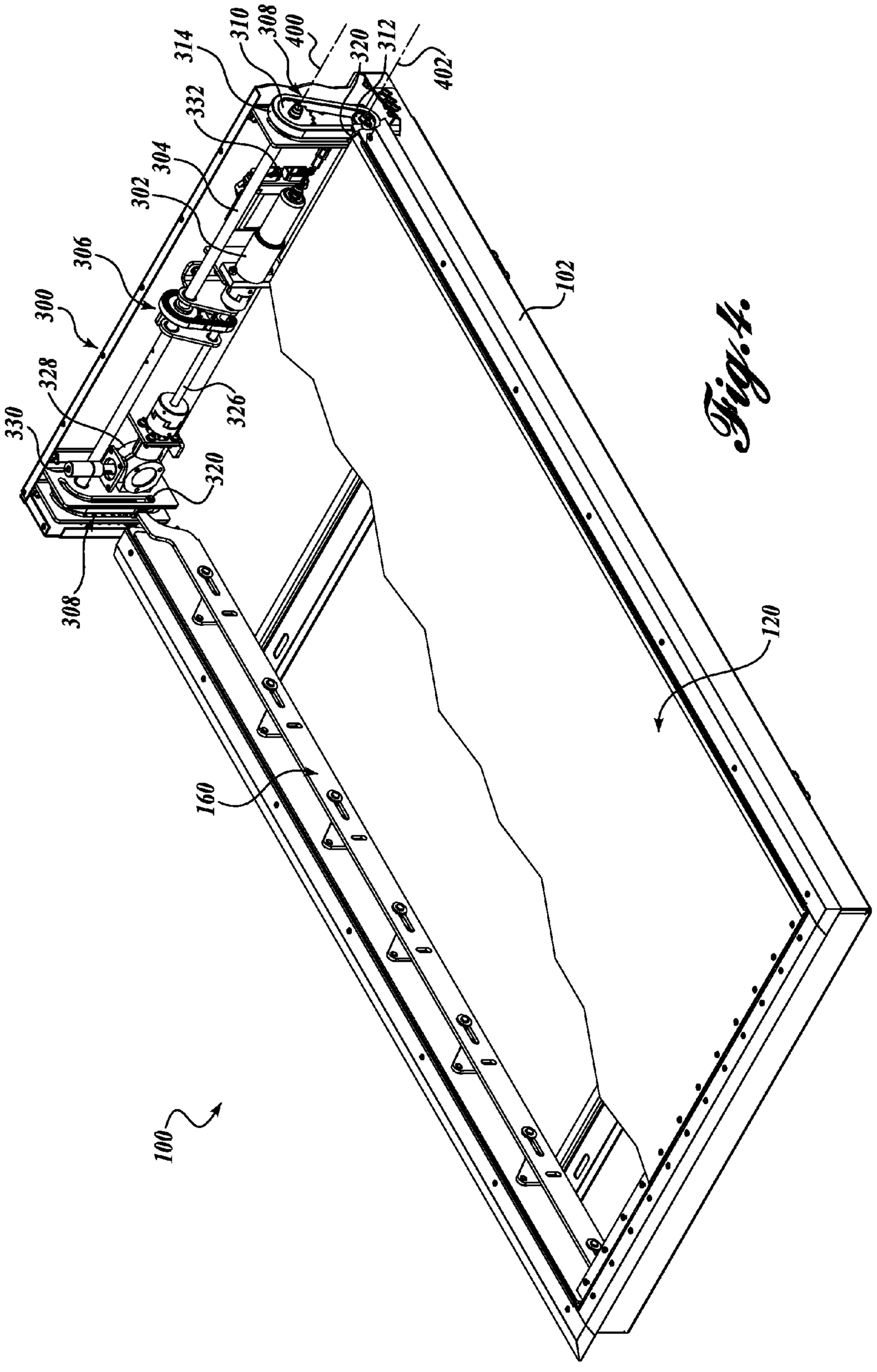
Fig. 3.


314
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308
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332
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302
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Fig. 4.

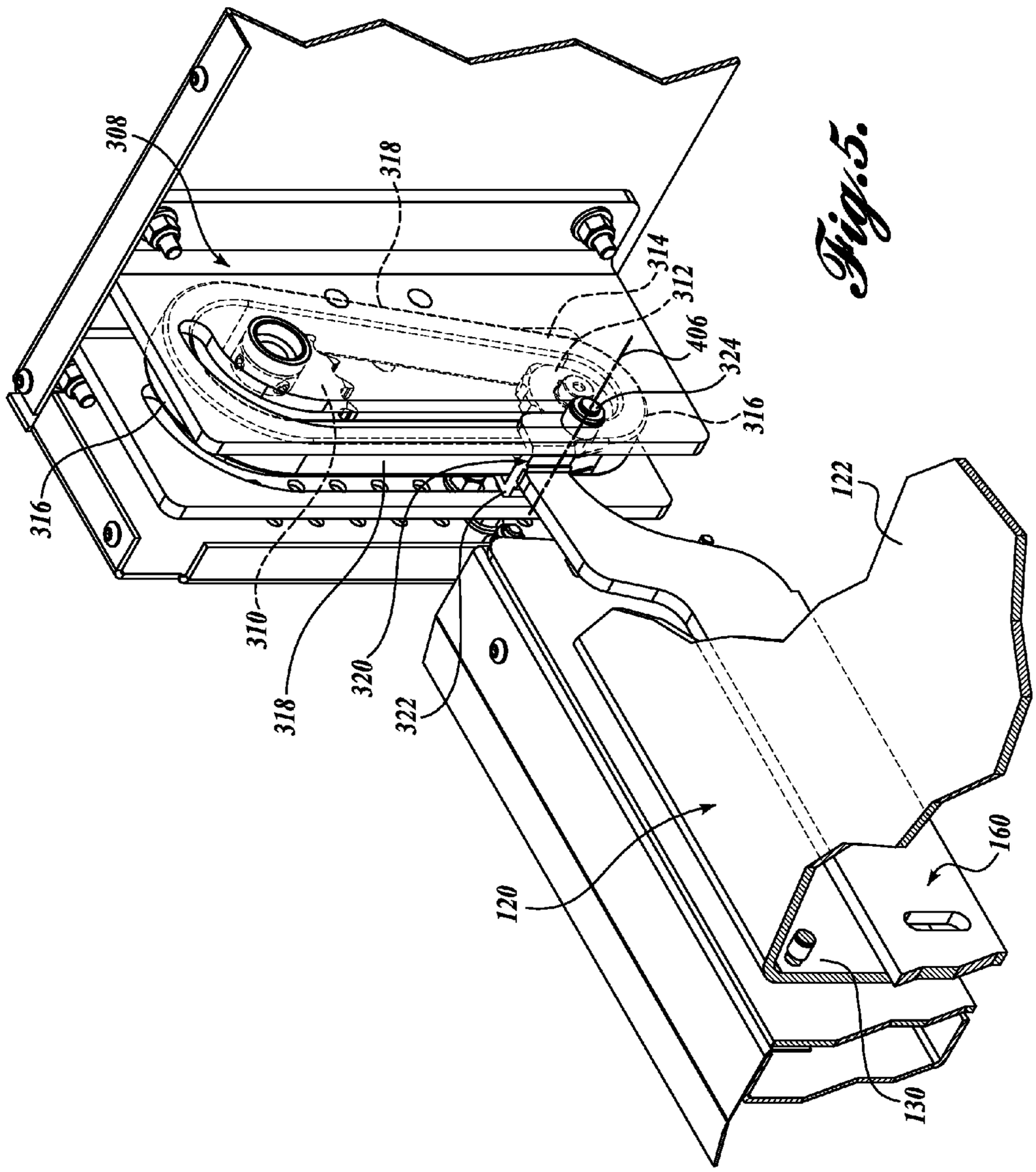

Fig. 5.

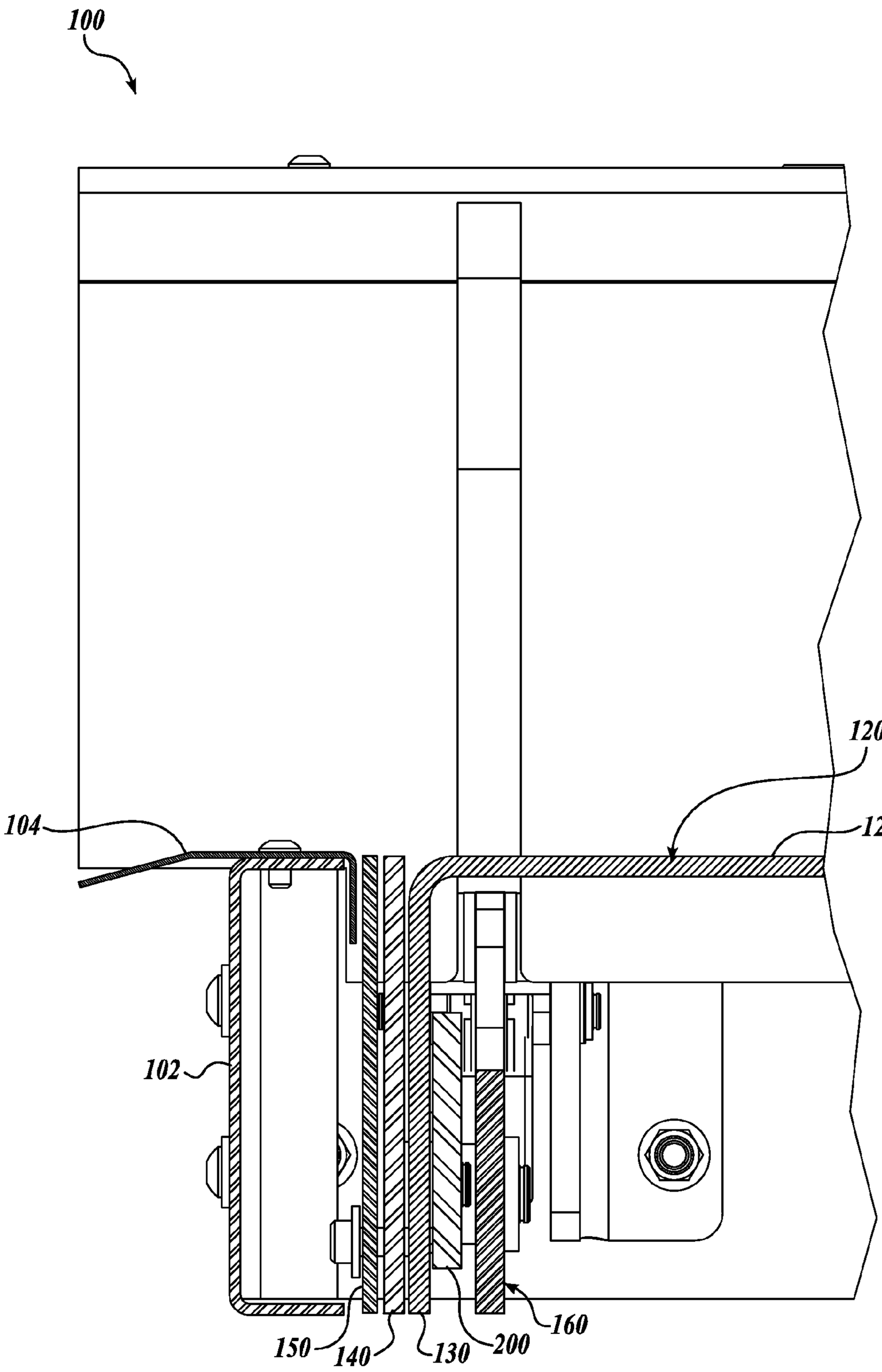

Fig. 6.

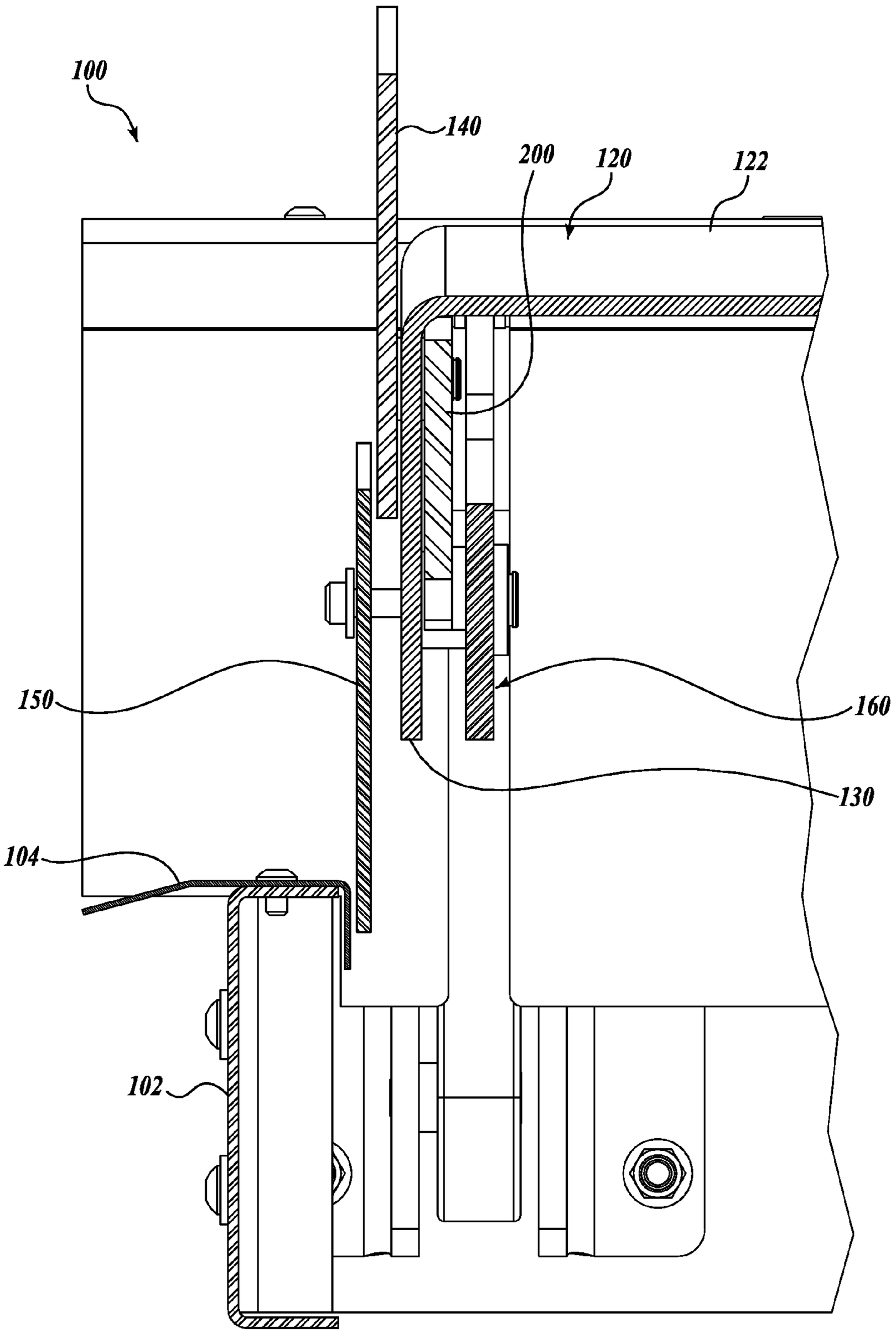

Fig. 7.

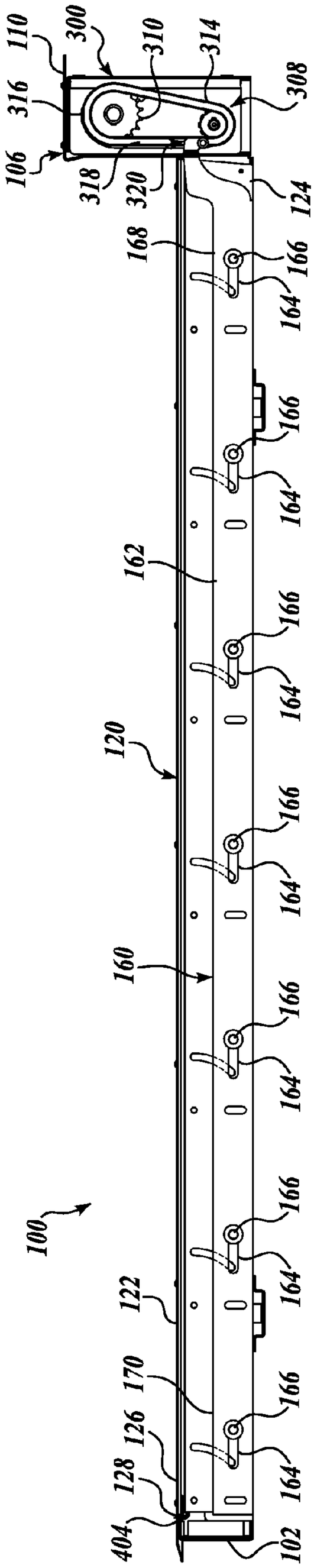
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Fig. 8.

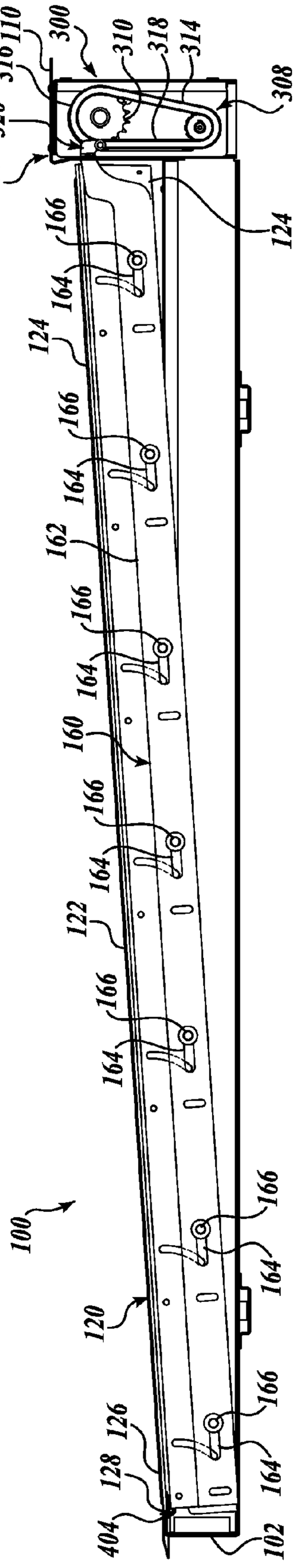
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Fig. 9.

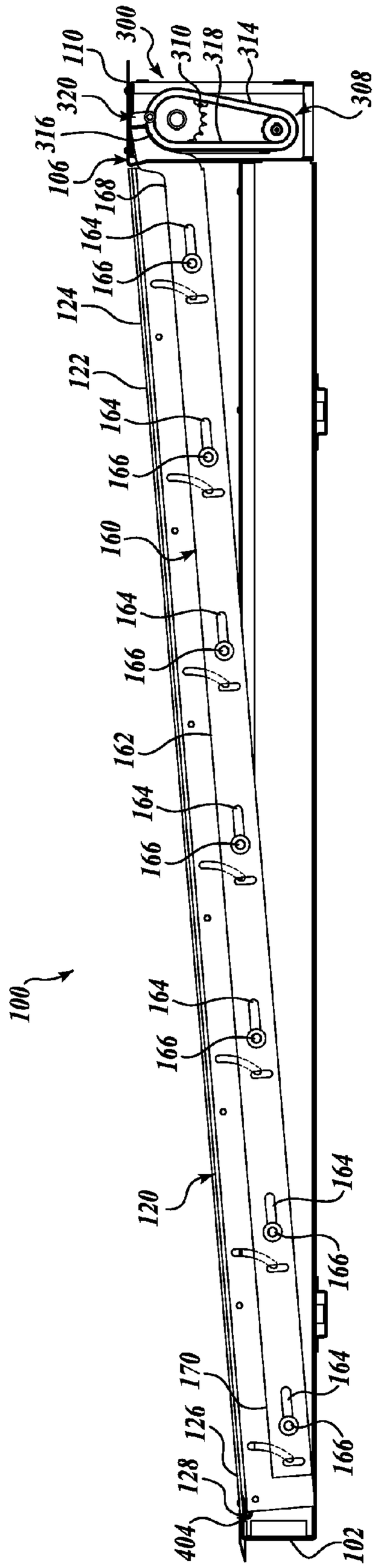
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Fig. 10.

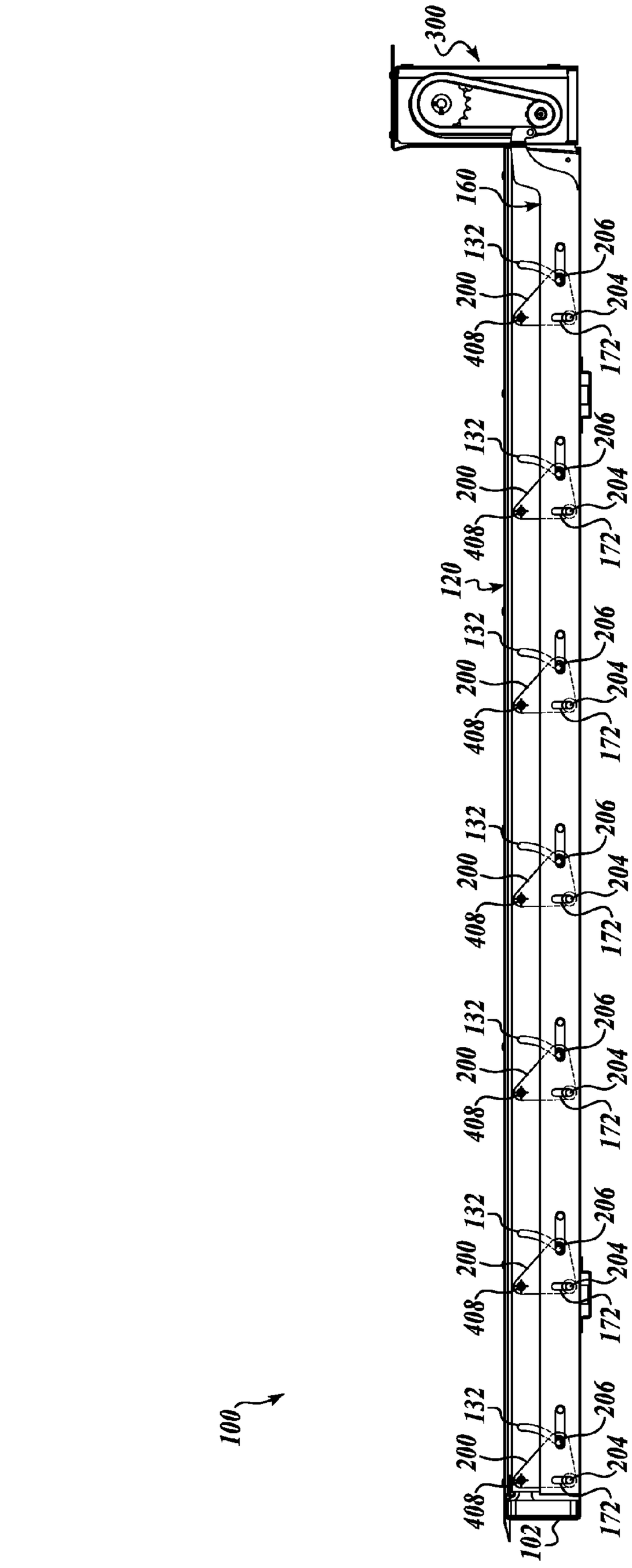

Fig. 11.

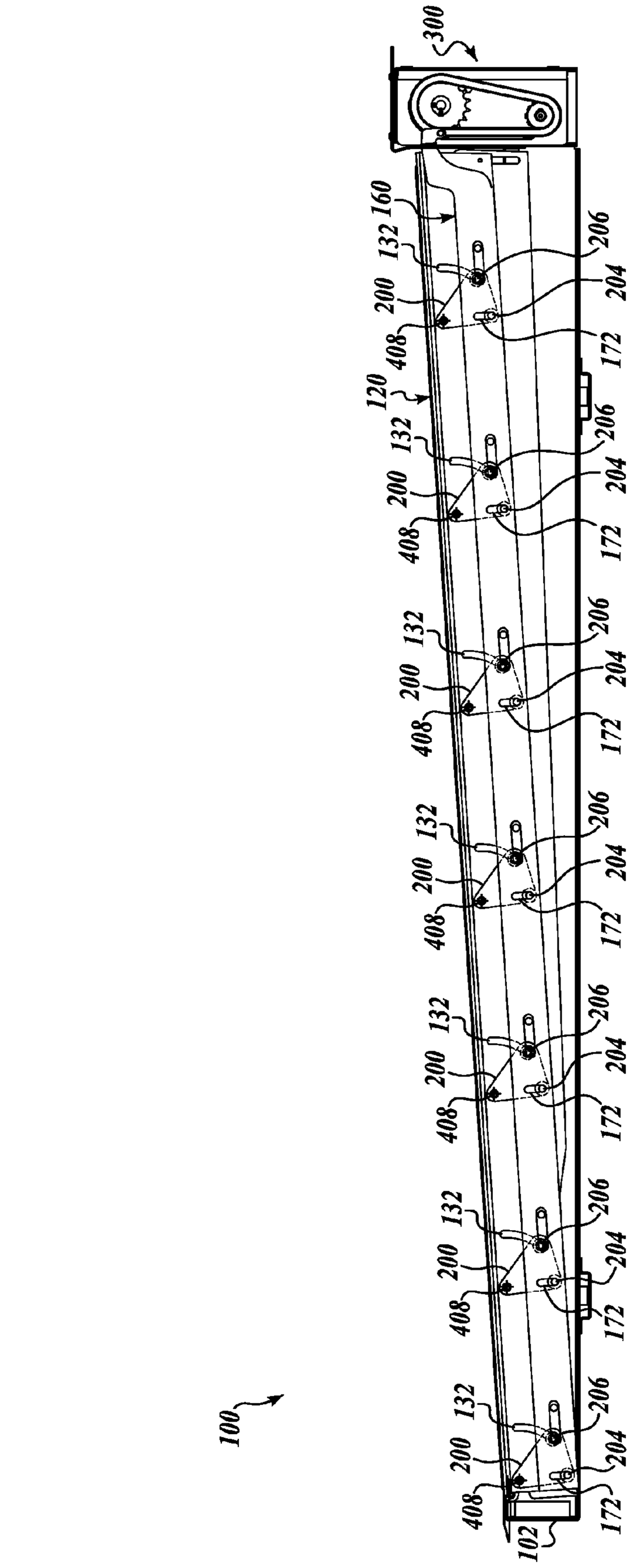

Fig. 12.

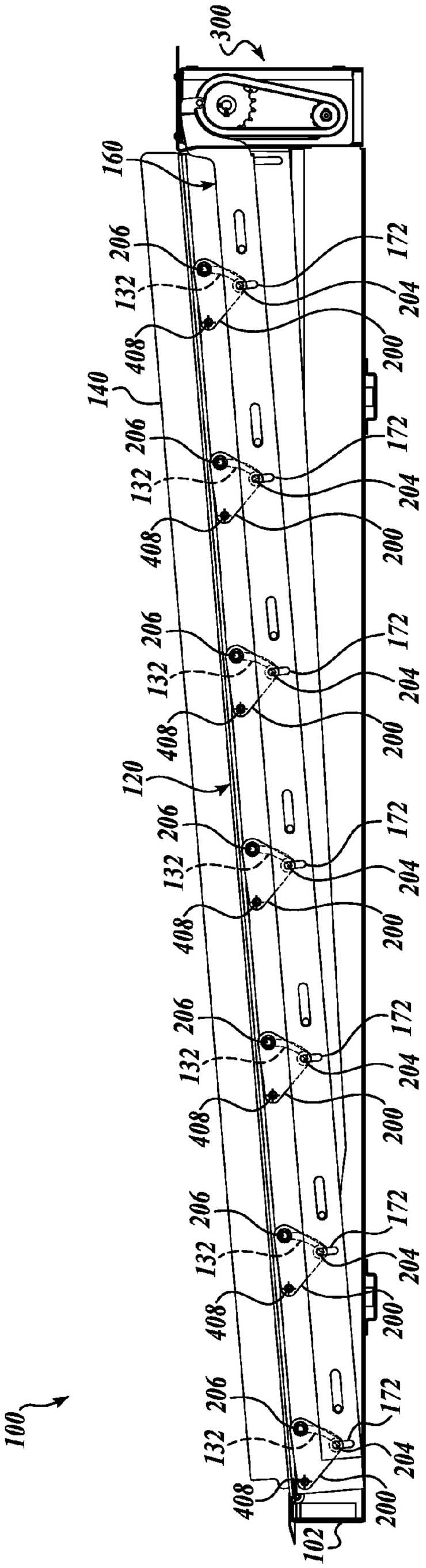

Fig. 13.

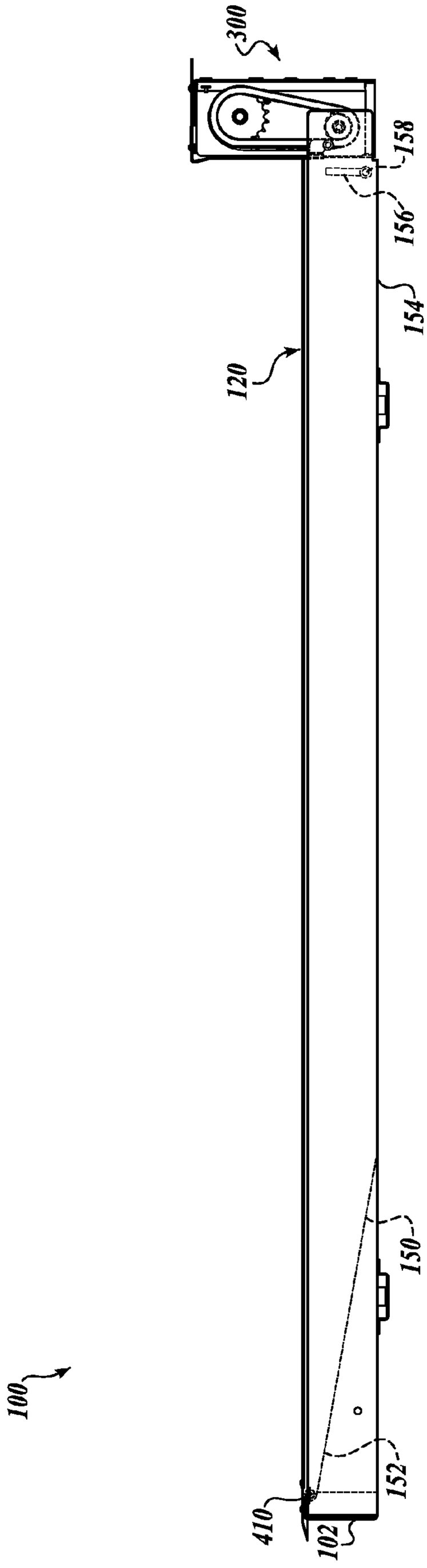

Fig. 14

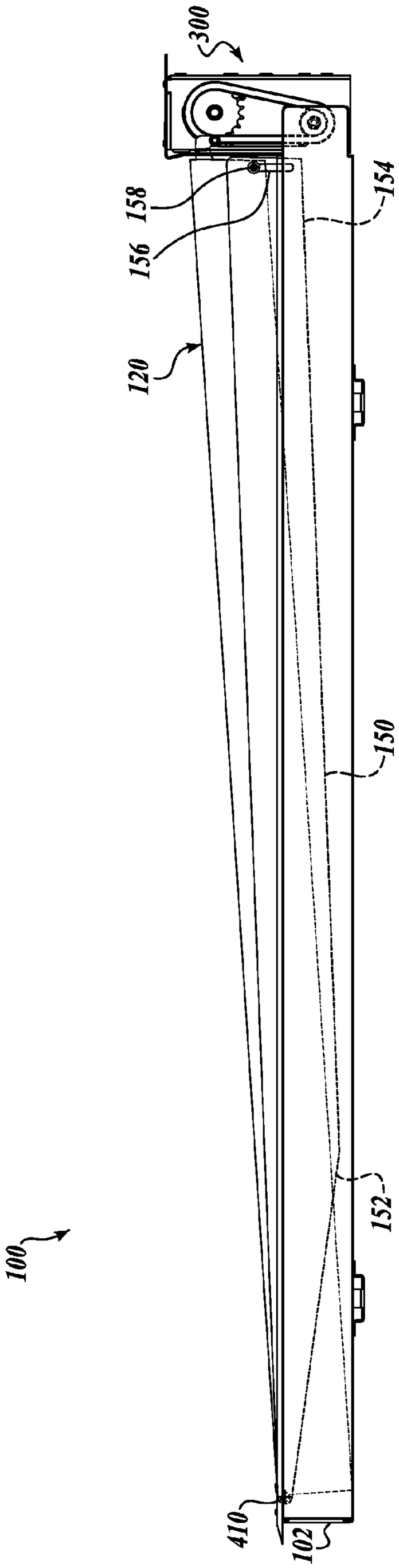

Fig. 15.

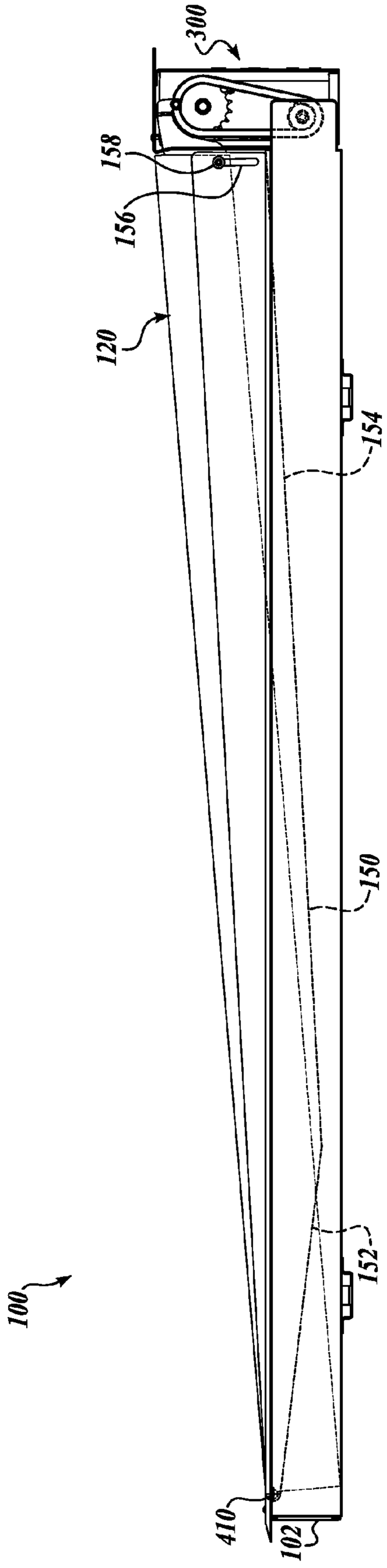

Fig. 16.

OPERABLE RAMP

CROSS-REFERENCE TO RELATED APPLICATION

This application is a division of application Ser. No. 14/302,752, filed Jun. 12, 2014, the disclosure of which is hereby incorporated by reference herein.

BACKGROUND

The Americans with Disabilities Act (ADA) requires the removal of physical obstacles to those who are physically challenged. The stated objective of this legislation has increased public awareness and concern over the requirements of the physically challenged. Consequentially, there has been more emphasis on providing systems that enable physically challenged people to access buildings and other architectural structures that have a step at the point of ingress or egress.

Installing a fixed ramp is a common way to provide the physically challenged with access to a building with one or more steps at the entrance. Fixed ramps take up a large amount of space and often detract from the aesthetic qualities of the building. Fold out ramps similar to those used in vehicles can be utilized, but deployment often requires a large area into which the ramps deploy. Accordingly, there is a need for a ramp that provides access to a building with a step at the entrance, while minimizing the space required by the ramp.

SUMMARY

This summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This summary is not intended to identify key features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter.

A first embodiment of an operable ramp is moveable between a lowered stowed position and a raised deployed position. The operable ramp has a ramp panel rotatable about a first axis located at a first end. A support element is slidingly coupled to the ramp panel. The operable ramp further includes a drive assembly comprising an endless loop coupled to an end of the support element. The endless loop has a linear portion and an arcuate portion. During a first phase of deployment, the end of the support element moves upward along the linear portion. During a second phase of deployment, the end of the support element moves along the arcuate portion of the endless loop.

A second embodiment of a disclosed operable ramp is moveable between a lowered stowed position and a raised deployed position. The operable ramp includes a ramp panel rotatable about a first axis located at a first end of the ramp panel. A support element is slidingly coupled to the ramp panel, and a drive assembly is coupled to the support element to selectively raise one end of the support element. Raising one end of the support element rotates the ramp panel about the first axis and moves the support element in a first direction relative to the ramp panel. The operable ramp further includes a side curb slidingly coupled to the ramp panel and operatively coupled to the support element. Movement of the support element in the first direction relative to the ramp panel moves the side curb upward relative to the ramp panel.

A third embodiment of a disclosed operable ramp is moveable between a lowered stowed position and a raised deployed position. The operable ramp includes a ramp panel rotatable about a first axis located at a first end. The operable ramp further includes a support element slidingly coupled to the ramp panel. A side curb is operatively coupled to the support element so that movement of the support element in the first direction relative to the ramp panel moves the side curb upward relative to the ramp panel. The operable ramp also includes a drive assembly coupled to the support element to selectively drive the operable ramp through a deployment motion. During a first phase of the deployment, the drive assembly rotates the ramp panel about the first axis. During a second phase of the deployment, the side curb moves the support element relative to the ramp panel.

DESCRIPTION OF THE DRAWINGS

The foregoing aspects and many of the attendant advantages of this invention will become more readily appreciated as the same become better understood by reference to the following detailed description, when taken in conjunction with the accompanying drawings, wherein:

FIG. **1** shows an isometric view of an exemplary embodiment of an operable ramp installed in an architectural setting with the operable ramp in a stowed position;

FIG. **2** shows an isometric view of the operable ramp of FIG. **1** between the stowed position and a deployed position;

FIG. **3** shows an isometric view of the operable ramp of FIG. **1** in the deployed position;

FIG. **4** shows a cutaway isometric view showing a drive assembly of the operable ramp of FIG. **1** with the operable ramp in the stowed position;

FIG. **5** shows a partial cutaway isometric view of the drive assembly of FIG. **4**;

FIG. **6** shows a cross-sectional end view of the operable ramp of FIG. **1** in the stowed position;

FIG. **7** shows a cross-sectional end view of the operable ramp of FIG. **1** in the deployed position;

FIG. **8** shows a cross-sectional side view of the operable ramp of FIG. **1**, showing a support element with the operable ramp in the stowed position;

FIG. **9** shows a cross-sectional side view of the operable ramp of FIG. **8**, showing the support element with the operable ramp between the stowed position and the deployed position;

FIG. **10** shows a cross-sectional side view of the operable ramp of FIG. **9**, showing the support element with the operable ramp in the deployed position;

FIG. **11** shows a cross-sectional side view of the operable ramp of FIG. **1**, showing a side curb with the operable ramp in the stowed position;

FIG. **12** shows a cross-sectional side view of the operable ramp of FIG. **11**, showing the side curb with the operable ramp between the stowed position and the deployed position;

FIG. **13** shows a cross-sectional side view of the operable ramp of FIG. **12**, showing the side curb with the operable ramp in the deployed position;

FIG. **14** shows a side view of the operable ramp of FIG. **1**, showing a side closeout with the operable ramp in the stowed position;

FIG. **15** shows a side view of the operable ramp of FIG. **14**, showing the side closeout with the operable ramp in between the stowed position and the deployed position; and

FIG. **16** shows a side view of the operable ramp of FIG. **15**, showing the side closeout with the operable ramp in the deployed position.

DETAILED DESCRIPTION

Exemplary embodiments of the presently disclosed operable ramp will now be described with reference to the accom-

panying drawings, where like numerals correspond to like elements. Exemplary embodiments of the disclosed subject matter are directed to operable ramps, and more specifically, to operable ramps that are selectively moveable between a stowed "step" position and a deployed "ramp" position. In particular, several embodiments of the present invention are directed to operable ramps for use in architectural settings such as building entrances in which the indoor and outdoor levels differ, for example, when the building entrance includes a step.

The following discussion proceeds with reference to examples of operable ramps suitable for use at building entrances wherein there is a change in elevation, i.e., a step up or step down. While the examples provided herein have been described with reference to their association with building entrances, it will be apparent to one skilled in the art that this is done for illustrative purposes and should not be construed as limiting the scope of the disclosed subject matter. Thus, it will be apparent to one skilled in the art that aspects of the disclosed operable ramp may be employed in a number of architectural settings, wherein a change in elevation, such as a step, provides an obstruction to a person with limited mobility.

The following detailed description may use illustrative terms such as higher, lower, inner, outer, vertical, horizontal, front, rear, proximal, distal, etc.; however, these terms are descriptive in nature and should not be construed as limiting. Further, it will be appreciated that embodiments of the disclosed subject matter may employ any combination of features.

FIGS. **1-3** show an exemplary embodiment of an operable ramp **100** installed in conjunction with a step **50**. The step **50** includes a horizontal first surface **52** located higher than and generally parallel to a lower second surface **54**. Like known step configurations, a vertical riser **56** extends between the first and second surfaces **52** and **54**.

Referring specifically to FIG. **1**, the operable ramp **100** is shown in the stowed position. The operable ramp **100** includes a frame **102** at least partially disposed below the second surface **54**. The frame **102** provides a structure with a fixed position to which the components of the operable ramp **100** are attached. To install the operable ramp **100** in conjunction with a step **50**, the frame **102** is attached to surrounding portions of the step to secure the operable ramp in place. It will be appreciated that the disclosed operable ramp **100** is not limited to use with a step, but can also be used in various other architectural settings in which a transition surface is required between a first and second surface. Further, although the illustrated embodiments of the operable ramp **100** include a frame **102**, other embodiments are contemplated in which the operable ramp **100** does not include a frame. To install such embodiments in conjunction with a step or in other architectural settings, the operable ramp **100** components are attached directly to the surrounding structure or to suitable structure within the building, thus making a frame **102** unnecessary. Accordingly, embodiments of the described operable ramp **100** that do not include a frame **102** should be considered within the scope of the present disclosure.

Still referring to FIG. **1**, the operable ramp **100** includes a ramp panel **120** and an inner closeout **106** constructed from well-known materials to have suitable strength and durability. The ramp panel **120** has a rectangular upper surface **122** that is generally flush with the lower second surface **54** when the operable ramp **100** is in the stowed position. One or more trim elements **104** extend laterally from the perimeter of the operable ramp **100** to provide a smooth transition between the upper surface **122** of the ramp panel **120** and the second surface **54**. An inner closeout **106** is positioned at the inner end of the ramp panel **120**. The inner closeout **106** includes a vertical surface **108** that is generally flush with the riser **56** of the step **50** and a horizontal surface **110** that is generally flush with the upper first surface **52**. Thus, as shown in FIG. **1**, the upper surface **122** of the ramp panel **120** and the inner closeout **106** cooperate to form part of the step **50** when the operable ramp **100** is in the stowed position.

The operable ramp **100** is selectively moveable from the stowed (step) position of FIG. **1** to the deployed (ramp) position of FIG. **3**. To move from the stowed position to the deployed position, the inner end **124** of the ramp panel **120** is raised. Raising the inner end **124** of the ramp panel **120** rotates the ramp about the outer end **126**, which is rotatably coupled to the frame **102** by a hinge **128**. It will be appreciated that embodiments are contemplated in which configurations other than a hinged attachment to the frame allow the ramp panel **120** to rotate about an axis located at or near the outer end **126** of the ramp panel, and such embodiments should be considered within the scope of the present disclosure.

As the ramp panel **120** moves through the intermediate position of FIG. **2** toward the deployed position of FIG. **3**, side curbs **140** are deployed upwardly along the sides of the ramp panel **120**. As shown in FIG. **3**, the side curbs **140** extend upward along the sides of the ramp panel **120** to provide barriers along the sides of the ramp in order to increase the safety of the operable ramp **100**.

When the operable ramp **100** is in the deployed position of FIG. **3**, the ramp panel **120** slopes downward from its inner end **124** so that the upper surface **122** of the ramp panel acts as a transition surface that extends from the upper first surface **52** to the lower second surface **54**. Side curbs **140** extend along the sides of the ramp panel **120** to prevent a wheelchair user from rolling off the side of the ramp panel. In addition, when the operable ramp is in the deployed position, a side closeout **150** extends downward from each side of the ramp panel **120** to prevent potential pinching conditions by blocking access to the area under the deployed ramp panel. As the operable ramp **100** moves from the deployed position of FIG. **3** back to the stowed position of FIG. **1**, the side curbs **140** retract, and the side closeout **150** moves downward with the ramp panel **120**.

As shown in FIGS. **4** and **5**, the operable ramp **100** includes a drive assembly **300** to selectively reciprocate the operable ramp between the stowed position and the deployed position. In the disclosed embodiment, the drive assembly **300** is positioned below the inner closeout **106**; however, various embodiments are possible in which all or some of the drive assembly components are located in other positions, and the disclosed exemplary configuration should not be considered limiting in this regard. As best shown in FIG. **4**, the drive assembly **300** includes a motor **302** selectively operated by a controller **332**. The motor **302** is operably coupled to a drive shaft **304** by a known transmission **306** so that the motor selectively rotates the drive shaft about a fixed axis **400**. The drive shaft **304** extends across the width of the operable ramp **100** and is coupled at each end to a chain assembly **308**. In the illustrated embodiment, the chain assemblies **308** are similar. Accordingly, one chain assembly **308** will be described with the understanding that the other chain assembly is likewise configured.

Referring now to FIG. **5**, the chain assembly **308** includes an upper sprocket **310** and a lower sprocket **312**. The upper sprocket **310** is coupled to the drive shaft **304** so that rotation of the drive shaft rotates the upper sprocket about the drive shaft axis **400**. The lower sprocket **312** is coupled to the frame **102** or some other fixed structure to be rotatable about an axis

402 that is parallel to the drive shaft axis 400. A chain 314 forms an endless loop that engages the upper and lower sprockets 310 and 312. In the illustrated embodiment, the path of the chain includes two arcuate portions 316, wherein the chain engages the sprockets 310 and 312 and two linear portions 318 separating the arcuate portions. A coupler 320 rotatably couples one end of a support element 160 to the chain 314 so that the end of the support element follows the path of the chain when the chain moves along the endless loop.

In other contemplated configurations, a rotatable drive arm or other suitable linkage is used in place of the chain assembly 308 to move the coupler 320 along a predetermined path. Further, the path of the coupler 320 can vary. In one contemplated embodiment, such as when a rotating drive arm is utilized, the coupler 320 follows an arcuate path through the entire deployment motion. These and other configurations are contemplated and should be considered within the scope of the present disclosure.

In the disclosed embodiment, the coupler 320 includes a clevis 322 rotatably supported by a pin 324 having an axis 406 that extends laterally from the chain 314. In the illustrated embodiment, the clevis 322 rests on the pin 324, allowing the ramp panel 120 to be rotated about the hinge 128 for easy access to the interior of the operable ramp 100; however, it will be appreciated that any number of suitable configurations can be utilized to rotatably couple the support element 160 to the chain assembly 308, and such configurations should be considered within the scope of the present disclosure.

As will be described in further detail, to move the operable ramp 100 from the stowed position to the deployed position, the motor 302 rotates the upper sprocket 310 in a first direction to drive the chain 314 in a first direction along the path of the endless loop, thereby raising the coupler 320 and, thus, the end of the support element 160. To move the operable ramp 100 from the deployed position to the stowed position, the motor 302 rotates the upper sprocket 310 in a second direction opposite the first direction, moving the chain 314 in a second direction along the path of the endless loop to lower the coupler 320 and, therefore, the end of the support element 160.

It will be appreciated that a number of alternate drive assemblies 300 can be utilized to selectively drive the chain 314 in first and second directions along the endless loop. In one alternate embodiment, two motors are utilized, each motor driving one of the chain assemblies 318 to reciprocate the operable ramp between the stowed position and the deployed position. In another alternate embodiment, instead of the disclosed motor with a rotary output, a linear actuator is operably coupled to each support element 160 through a linkage. In yet another possible embodiment, the drive assembly 300 includes a counterbalance to reduce the force required to actuate the operable ramp 100, thereby decreasing the size of the motor. These and other configurations that selectively raise and lower the ends of the support elements 160 are contemplated and should be considered within the scope of the present disclosure.

Referring back to FIG. 4, a secondary shaft 326 is operably coupled to the drive shaft 304 through the transmission 306 such that rotation of the secondary shaft in a first direction rotates the upper sprocket 310 in a first direction, and rotation of the secondary shaft in a second direction rotates the upper sprocket 310 in a second direction. A second end of the secondary shaft 326 is coupled to the output of a gearbox 328. The gearbox 328 includes an upward facing input shaft having a keyway 330, which is accessible from above the inner closeout 106 through an access hole 112, shown in FIGS. 1-3.

In the event of a loss of power or a motor failure, an operator can actuate the operable ramp 100 manually. To do so, the operator inserts a crank through the access hole 112 into the keyway 330 and rotates the crank in a first direction to move the operable ramp 100 toward the deployed position, and in a second direction to move the operable ramp toward the stowed position. It will be appreciated that a number of variations to the illustrated manual deploy mechanism can be incorporated. In this respect, the size, position, and configurations of mechanisms that transfer a manual input into rotation of the drive shaft 304 can vary, and such variations should be considered within the scope of the present disclosure.

Referring now to FIGS. 6 and 7, the ramp panel 120 has a C-shaped cross-section, with a vertical leg 130 extending downward from the upper surface 122 along each side of the ramp panel. Although FIGS. 6 and 7 show one only one side of the ramp panel 120, the other side of the ramp panel and the associated components are a mirror image of FIGS. 6 and 7, or similarly configured. Accordingly, the illustrated side of the ramp panel 120 and associated components are described herein with the understanding that the other side of the ramp panel and the related components operate in a similar manner.

Still referring to FIGS. 6 and 7, a support element 160 is positioned under the ramp panel 120 adjacent to the vertical leg 130. As will be described later, a lifting element 200 is disposed between the vertical leg 130 and the support element 160. A side curb 140 is positioned next to the vertical leg 130 opposite the lifting element 200 and support element 160. A side closeout 150 is positioned next to the side curb 140 so that the side curb is located between the side closeout and the vertical leg 130. As shown in FIG. 6, when the operable ramp 100 is in the stowed position, the upper edges of the side curb 140 and the side closeout 150 are flush with or lower than the upper surface 122 of the ramp panel 120. When the operable ramp 100 is in the deployed position, the side curb 140 extends upward from the ramp panel 120 and the side closeout 150 extends downward from the ramp panel.

Referring now to FIGS. 8-10, the support element 160 is associated with the drive assembly 300 to selectively raise and lower the ramp panel 120. The support element 160 has an elongate body 162 that extends at least part of the length of the ramp panel 120. A plurality of spaced apart horizontal slots 164 are formed in the body 162 to enable the support element 160 to be slidingly coupled to the ramp panel 120. In this regard, a plurality of bearing elements 166 are coupled to the vertical leg 130 of the ramp panel 120 and extend inwardly, each bearing element extending through one of the horizontal slots. Thus, the support element 160, which is coupled to the ramp panel 120 by the engagement of the horizontal slots 164 with the bearing elements 166, is capable of sliding relative to the ramp panel 120, as shown in FIGS. 8-10. It will be appreciated that the support element 160 may be slidingly coupled to the ramp portion 120 utilizing any suitable configuration that allows relative motion between the support element and the ramp portion, and such configurations should be considered within the scope of the present disclosure.

As previously described, the outer end 126 of the ramp panel 120 is hingedly coupled to the frame 102 by a hinge 128 to be rotatable about hinge axis 404. Thus, the hinge 128 supports the outer end 126 of the ramp panel 120, which in turn supports the support element 160, so that both the ramp panel and the support element are rotatable about axis 404.

As previously described, the coupler 320 disposed on the inner end 168 of the support element 160 engages the chain assembly 308 so that the chain assembly both supports and selectively positions the inner end of the support element.

Because the support element **160** is slidably coupled to the ramp panel **120**, the chain assembly **308** also supports and selectively positions the inner end **124** of the ramp panel.

When the operable ramp **100** is in the stowed position of FIG. **8**, the ramp panel **120** is supported in a generally horizontal position by the hinge **128** and the chain assembly **308** via the coupler **320**. When the operable ramp **100** is so positioned, the coupler is located along a linear portion **318** of the chain **314**.

To move the operable ramp **100** through a first phase of deployment, the motor **302** rotates the upper sprocket **310** (the drive sprocket) in a clockwise direction as viewed in FIGS. **8** and **9**. Rotation of the upper sprocket **310** in a clockwise direction moves the chain **314** and, therefore, the coupler **320**, along the path of the endless loop formed by the chain. During the first deployment phase, the coupler **320** moves upward along a linear portion **318** of the chain assembly **308**, thereby raising the outer end **168** of the support element **160** and rotating the ramp panel **120** upward about its outer end **126**. In the illustrated embodiment, the linear portion **318** of the chain assembly **308** is positioned to be approximately vertical. Accordingly, only minor relative motion occurs between the ramp panel **120** and the support element **160** as the inner end **168** of the support element is raised.

The first deployment phase ends when the coupler **320** reaches the upper end of the linear portion **318** of the chain **314**, as shown in FIG. **9**. From this intermediate position, further rotation of the upper sprocket **310** in a clockwise direction as viewed in FIG. **9** drives the operable ramp **100** through a second deployment phase until the operable ramp reaches the deployed position of FIG. **10**. As the chain **314** continues to move in a clockwise direction (as viewed in FIGS. **9** and **10**) along the path of the endless loop, the coupler **320** moves along an arcuate portion **316** of the chain. That is, the coupler **320** moves upward as well as inward. The upward motion of the coupler **320** continues to raise the inner end **124** of the ramp panel **120** until the end of the ramp panel is aligned with the horizontal surface **110** of the inner closeout **106**, i.e., until the ramp panel is positioned to provide a transition surface between the upper first surface **52** and lower second surface **54**.

As the operable ramp **100** moves through the second deployment phase, the inward movement of the coupler **320** slides the support element **160** relative to the ramp panel **120**. More specifically, the outer end **126** of the ramp panel **120** maintains a fixed distance from axis **404**, while the inner end **168** of the support element **160** moves inwardly with the coupler.

To move the operable ramp **100** from the deployed position of FIG. **10** to the stowed position of FIG. **8**, the motor **302** rotates the upper sprocket **310** in a counterclockwise direction as viewed in FIGS. **8-10** to drive the chain **314** in the counterclockwise direction along the path of the endless loop. As the operable ramp **100** moves from the deployed position of FIG. **10** to the intermediate position of FIG. **9**, the coupler **320** moves downward and outward along the arcuate portion **316** of the chain **314**. Movement along the arcuate portion **316** of the chain **314** lowers the inner end **124** of the ramp portion **120** and moves the support element **160** outward relative to the ramp panel.

As the operable ramp **100** moves from the intermediate position toward the stowed position, the coupler **320** enters the linear portion **318** of the chain **314**. From there, the coupler **320** moves downward along the linear portion **318** of the chain **314**, which moves the inner end **124** of the ramp panel **120** downward until the operable ramp **100** has reached the stowed position of FIG. **8**. As the coupler **320** moves downward along the linear portion **318** of the chain **314**, relative motion between the ramp panel **120** and the support element **160** is minimal.

Referring now to FIGS. **11-13**, actuation of the side curb **140** will be described. A plurality of lifting elements **200** are rotatably coupled to the inside surface of each vertical leg **130** of the ramp panel **120** about an axis **408**. As shown in FIGS. **6** and **7**, each lifting element **200** is disposed between the support element **160** and the vertical leg **130** of the ramp panel **120**. In the illustrated embodiment, each lifting element **200** has a generally triangular profile and is formed from metal sheet or plate; however, other suitable shapes and material are possible within the scope of the present disclosure.

Referring back to FIGS. **11-13**, a vertical slot **172** is formed in the support element **160** at each lifting element **200**. A bearing element **204** extends from each lifting element **200** to slidingly engage the corresponding vertical slot **172**. As best shown in FIGS. **12** and **13**, when the support element **160** moves relative to the vertical leg **130** of the ramp panel **120**, each bearing element **204** cooperates with the corresponding vertical slot **172** to rotate the lifting element **200** about axis **408**.

A pin **206** extends laterally from each lifting element **200** through the vertical leg **130** of the ramp panel **120** to rotatably couple the lifting element to the side curb **140**. The pin **206** is rotatably coupled to the lifting element **200**, the side curb **140**, or both to allow for rotation of the lifting element relative to the side curb. The pins **206** support the side curb **140** so that rotation of the lifting elements **200** in a first direction raises the side curb relative to the ramp panel **120**, and rotation of the lifting elements **200** in a second direction lowers the side curb relative to the ramp panel.

Each pin **206** corresponds to an arcuate slot **132** formed in the vertical leg **130** of the ramp panel **120**. The arcuate slot **132** corresponds to the path of the pin **206** when the lifting element **200** rotates about axis **408**. The arcuate slot **132** is sized to be larger than the diameter of the pin **206** so that the pin travels unimpeded along the slot when the lifting element **200** rotates in response to relative motion between the support element **160** and the ramp panel **120**.

As the operable ramp **100** moves from the stowed position of FIG. **11** to the intermediate position of FIG. **12**, there is little to no relative movement between the support element **160** and the vertical leg **130** of the ramp panel **120**. As a result, rotation of the lifting elements **200** about axes **408** is negligible. As the operable ramp **100** moves from the intermediate position of FIG. **12** to the deployed position of FIG. **13**, the support element **160** moves relative to the vertical leg **130** of the ramp panel **120** to rotate the lifting elements **200** in a counterclockwise direction as viewed in FIGS. **11-13**. Rotation of the lifting elements **200** drives the pins **206** upward along the arcuate slots **132** to raise the side curb **140** to the deployed position of FIG. **13**.

When the operable ramp **100** moves from the deployed position of FIG. **13** to the intermediate position of FIG. **12**, the movement of the support element **160** relative to the vertical leg **130** of the ramp panel **120** rotates the lifting elements **200** in the clockwise direction as viewed in FIGS. **11-13**. Rotation of the lifting elements **200** in the clockwise direction retracts the side curb **140** to a position below the upper surface **122** of the ramp panel. In the illustrated embodiment, when the operable ramp **100** moves from the intermediate position of FIG. **12** to the stowed position of FIG. **11**, there is little to no relative movement between the support element **160** and the vertical leg **130** of the ramp panel **120**, so rotation of the lifting elements **200** about axes **408** is negligible.

In the illustrated embodiment, the side curbs **140** are generally stowed when the operable ramp **100** is between the intermediate position and the stowed position. That is, relative motion between the support element **160** relative to the vertical leg **130** of the ramp panel **120** is negligible when the operable ramp moves between the intermediate position and the stowed position. It should be appreciated, however, that other configurations are possible such that the side curbs **140** deploy throughout the entire deployment motion or through a different part of the deployment motion. For example, in one exemplary alternate embodiment, the chain assembly **308** is configured such that coupler **320** moves along an angled path to impart relative motion between the support element **160** and the vertical leg **130** of the ramp panel **120** throughout the motion of the ramp. In another contemplated embodiment, the chain assembly **308** is configured to impart relative motion between the support element **160** and the vertical leg **130** of the ramp panel **120** during the first phase of deployment and then limiting the relative motion during a second phase. For such a configuration, the side curbs would deploy immediately upon starting of the deployment motion. These and other configurations for providing different timing of the side curb deployment are contemplated and should be considered within the scope of the present disclosure.

Referring now to FIGS. **14-16**, a side closeout **150** extends down from the ramp panel **120** to eliminate a potential "pinch point" under the ramp panel when the operable ramp is in the deployed position. As shown in FIGS. **6** and **7**, the side closeout **150** is positioned adjacent and generally parallel to the side curb **140**. A first end **152** of the side closeout is rotatably coupled to the frame **102** about an axis **410**. In the illustrated embodiment, axis **410** is coincident with the axis **404** of the hinge **128**; however, it is not necessary that axes **410** and **404** be so positioned. Moreover, the side closeout **150** is not limited to being rotatably coupled to the frame **102**, but can be rotatably coupled to other suitable structure, such as the ramp panel **120**, for example.

A second end **154** of the side closeout **150** includes an elongate slot **156**. A bearing element **158** extends laterally from the vertical leg **130** of the ramp panel **120** to engage the slot **156**. When the operable ramp is in the stowed position of FIG. **14**, the side closeout is beside the side curb **140** and below or flush with the upper surface **122** of the ramp panel **120**, as shown in FIG. **6**. As the operable ramp **100** moves through the deployment motion, the ramp panel **120** rotates about axis **404**, and the bearing element **158** moves upward along the slot **156**. When the bearing element **158** reaches the upper end of the slot **156**, continued rotation of the ramp panel **120** lifts the second end **154** of the side closeout **150** so that the side closeout rotates about axis **410**. Thus, the upper edge of the side closeout **150** follows the vertical leg **130** of the ramp panel **120** as the operable ramp **100** moves to the deployed position of FIG. **16**. When in the deployed position, the side closeout **150** extends below the ramp panel **120** to block access to a gap under the ramp panel **120** that would otherwise be accessible.

When the operable ramp **100** moves from the deployed position of FIG. **16** to the stowed position of FIG. **14**, the side closeout **150**, which is supported by the bearing element **158** and the hinged connection at axis **410**, initially moves down with the ramp panel **120**. During the movement toward the stowed position, the side closeout **150** contacts a lower portion of the frame or some other suitable structure that engages the side closeout such that further rotation of the ramp panel **120** moves the bearing element **158** downward along the slot **156** while the side closeout maintains a fixed position. The ramp panel **120** continues to move downward until the operable ramp **100** reaches the stowed position of FIG. **14**.

While illustrative embodiments have been illustrated and described, it will be appreciated that various changes can be made therein without departing from the spirit and scope of the invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An operable ramp moveable between a lowered stowed position and a raised deployed position, the operable ramp comprising:

(a) a ramp panel rotatable about a first axis located at a first end;

(b) a support element slidingly coupled to the ramp panel; and

(c) a drive assembly comprising an endless loop coupled to an end of the support element, the endless loop having a linear portion and an arcuate portion, wherein (i) the end of the support element moves upward along the linear portion during a first phase of deployment, and (ii) the end of the support element moves along the arcuate portion during a second phase of deployment.

2. The operable ramp of claim **1**, wherein movement of the end of the support element along the arcuate portion moves the support element relative to the ramp panel.

3. The operable ramp of claim **2**, wherein movement of the end of the support element along the arcuate portion moves the end of the support element upward.

4. The operable ramp of claim **2**, further comprising a side curb operably coupled to the ramp panel, wherein movement of the support element relative to the ramp panel in a first direction raises the side curb.

5. The operable ramp of claim **4**, wherein movement of the support element relative to the ramp panel in a second direction lowers the side curb.

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